ABRIDGED

INTEREST TABLES.

BY

M. L. EDMUNDS.

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INTRODUCTION.

The importance of a method that can be readily applied in the calculation of interest, has led to the exercise of considerable ingenuity in order to discover the shortest and simplest rule in practice. The object of this work is to present a method for computing interest, not only *brief*, but one that will give *correct interest*; this being a feature in which most methods are deficient in consequence of reckoning time incorrectly. It may be readily seen that an error arises in the use of all methods for calculating interest, whereby the month is reckoned at 30 days, and consequently the year at 360 days; hence the objection to the favorite 6 per cent. method, also to various other methods, which, by reckoning 360 days to the year, give, for fractional parts of a year, an amount of interest ex-

ceeding the exact interest by the same ratio that 365 days exceed 360 days.

Exact interest, obtained by reckoning 365 days to the year, is growing in favor with bankers and other business men, is the method of interest used by the United States Government and by foreign correspondents, is the method of interest becoming the most popular, and which ultimately is destined to be in universal use.

In solving problems in simple interest, the primary object is to find the interest on a given principal for a given time and rate. That method which is the most natural and simple in principle, is to find the interest for one year by multiplying the principal by the rate, and then multiplying this interest by the time in years. The objection to this method, heretofore, has been in the difficulty of multiplying by the time, which, given in months and days, has been considered incapable of being reduced to convenient fractional parts of a year. The method of interest presented in this work, *by having all fractional parts of a year ex-*

pressed decimally, enables us to follow the natural process, while at the same time it gives the shortest method possible for calculating exact interest—*a desideratum hitherto unsupplied by any treatise on the subject.*

There being 365 days in a year, it is impossible to divide the year into months each containing an equal number of entire days, and therefore impracticable to reckon time in months. This difficulty may be obviated by using methods whereby interest is calculated for the number of days. Indeed, the only correct methods are those by which interest, for periods of time less than one year, is calculated for the exact number of days; and the most practical method is that which by the most natural process, with the least amount of labor, will give exact interest.

The amount of table-work, not aggregating one-half page, all of which should be thoroughly committed to memory, forms a desirable feature of this method; namely, the ease and rapidity with which we are

enabled to compute time and to reduce days to decimal years. It may also be observed that if such periods of time as are in frequent use have their decimal years memorized, the computation of interest for these periods becomes susceptible of easy and rapid calculation.

The method is conveniently treated under three cases, viz: *To find the time; to express the time decimally;* and *to find the exact interest.* To this is appended a general rule, also a variety of problems illustrating the process of obtaining, and multiplying by, the decimal years.

Having prosecuted the work with the view of facilitating the calculation of interest, the author now submits his method to the consideration of those whose avocations demand a practical treatise on this important subject, and leaves whatever merit the method deserves to the decision of those competent to judge.

M. L. EDMUNDS.

ABRIDGED INTEREST TABLES.

TO FIND THE TIME.

In order to compute time readily, the following table, which gives the number of days in the year previous to the first day of each month, should be committed to memory:

January..... 0	May........120	September...243
February....31	June.......151	October.......273
March........59	July.......181	November...304
April.........90	August...212	December....334

To find the difference of time between two dates, we first find the day of the year of each date by *adding the day of the month of each date respectively to the numbers in the table corresponding to the given months*, and then *subtract the day of the year of the former date from the day of the year of the latter date*, to find the difference of time in days between two dates in the same year; or, *subtract the day of the year of the former date from* 365 *and add the remainder to the day of*

the year of the latter date, if the dates are in consecutive years, and the time less than one year; or, *determine the number of entire years, and then reckon the exact number of days remaining, by the foregoing rules*, if the time exceeds one year; and *add* 1 *to the number of days found by the table*, in passing over February in leap year.

Example 1.—Should you want to find the day of the year corresponding to March 10th, determine the number of days in the year previous to the first day of March, which is shown by the table to be 59, to which add the day of the month, and you find March 10th to be the 69th day of the year.

Example 2.—To find the difference of time between February 12th, the 43rd day of the year, and July 20th, the 201st day of the year, take the difference between 201 and 43, which is 158, the difference of time in days.

Example 3.—The difference of time in days between November 15th, the 319th day of the year, and February 10th, the 41st day of the year following, is found by adding the difference between 365 and 319, which is 46, the number of days from November 15th to the close of the year, to 41, which gives 87 days.

TO EXPRESS THE TIME DECIMALLY.

Since each day is 1-365th of a year, there will be as many 365ths of a year in any given time as there are days, and the fractional part of a year thus represented may be reduced to a decimal year by *annexing ciphers to the number of days and dividing by* 365; the quotient thus obtained will be the time expressed decimally.

EXAMPLE.—Reduce 97 days to a decimal year.

SOLUTION.—97 days equal 97-365ths of a year; and 97.0 divided by 365 equals .265+; hence 97 days equal .265+ of a year.

To facilitate the process of reducing days to decimal years, commit to memory the following table:

365×1= 365	365×4=1460	365×7=2555
365×2= 730	365×5=1825	365×8=2920
365×3=1095	365×6=2190	365×9=3285

THE DECIMAL YEAR.

In reducing days to decimal years, we annex ciphers to the number of days and divide by 365. The division will in most cases result in decimals which do not terminate, but, when expanded sufficiently far, will result in a series of figures called the repetend, which will constantly repeat in the same order. Such decimals are called circulating decimals, and those repetends in which the terms of the first half are respectively equal to 9 minus the corresponding terms of the second half, are called complementary repetends.

Let the reduction of $97.\dot{0} \div 365$ be continued five decimal places, and we have 2, the finite or non-repeating part of the decimal, and 6575, the first half of the repetend. Subtracting the terms of the first half of the repetend respectively from 9 gives 3424, the terms of the last half, and we have the mixed circulate $.2\dot{6}575342\dot{4}$, whose repetend is complementary. It is therefore evident that in making such reduction, or in memorizing a decimal year, it is unnecessary to continue the reduction or the memorizing further than is required to determine the first half of the repetend, since any number of terms following may be determined from the first half of the repeating part.

When the number of days is 73, or a multiple of 73, the corresponding decimal year terminates with tenths. When the number of days is 5, or a multiple of 5, the corresponding decimal year results in a circulate whose repetend begins with the first term of the decimal. All other decimal years are circulates whose

repetends begin with the second term of the decimal. The repetend of any circulating decimal year is complementary and consists of eight terms, and may be indicated by placing a period over the first and the last figures.

As the number of decimal places ordinarily required is from three to five, the above principles of circulates are employed to expedite the process of reduction only when interest is required on extremely large amounts, or when decimals are to be memorized.

TO FIND THE EXACT INTEREST.

Multiplying the principal by the rate of interest gives the interest for one year, and this interest multiplied by the time in years gives the required interest.

The process of multiplying by the time, when expressed decimally, is performed by *multiplying the interest for one year by the number of entire years, and each decimal division of the interest for one year by the corresponding decimal part of the given time, and taking the sum of these products.*

This process enables us to contract each product to the required denomination, and to reject all products of a lower denomination than required in the entire product.

EXAMPLE. — Required the interest of $3987, for 2 years and 316 days (2.86575+ years), at 5 per cent.

OPERATION.

```
 $3987=Principal.
   .05=Rate.
------
 199.35=Interest for one year.
57568.2=Time expressed decimally.
------
 398.70=Interest for 2 years.
 159.48=Interest for 8 tenths of a year.
  11.96=Interest for 6 hundredths of a year.
   1.00=Interest for 5 thousandths of a year.
    .14=Interest for 7 ten-thousandths of a year.
      1=Interest for 5 hundred-thousandths of a
------      year.
$571.29=Required interest.
```

SOLUTION.—Multiplying the principal, $3987, by the rate, .05, gives $199.35 interest for one year; and this interest divided by 10, 100, 1000, etc., which may be effected by moving the decimal point one, two, three, etc. places to the left, will give $19.93+, $1.99+, $0.19+, etc., which equal the interest for one-tenth of a year, one-hundredth of a year, one-thousandth of a year, etc. By writing the number of entire years—2, and the terms of the decimal years, which are tenths of a year—8, hundredths of a year—6, thousandths of a year—5, etc., respectively under the right hand terms of the interest for one

year—$199.35, one-tenth of a year—$19.93+, one-hundredth of a year—$1.99+, one thousandth of a year—$0.19+, etc., we have the terms of the decimal years written in an inverted order, at the left of years, each properly written under that division of the year's interest to be multiplied by it. We multiply the interest for one year, one-tenth of a year, one-hundredth of a year, one-thousandth of a year, etc., respectively by the number of entire years, tenths of a year, hundredths of a year, thousandths of a year, etc., increasing each of these products by as many units as would have been carried to it from the product of the rejected terms, and one more when the second term towards the right in the product of the rejected terms is 5 or more than 5; and place the right hand terms of these products in the same column. The sum of these products gives the required interest.

NOTE 1.—The rejected terms are the denominations lower than cents in the interest, and decimal divisions of the interest for one year.

NOTE 2.—The terms of the decimal years must be extended one place farther to the left than the terms of the number expressing the interest for one year, in order to obtain the last product, which is equal only to the number of units that would have been carried from the product of the rejected terms.

GENERAL RULE.

1. *Multiply the principal by the rate of interest, to find the interest for one year.*

2. *Write the number of entire years, when not exceeding* 9, *using a cipher if the time is less than one year, under that part of the interest for one year, generally cents, which is of the lowest denomination in the required interest. Annex ciphers to the number of days and divide by* 365, *and write the quotient figures, which will be tenths of a year, hundredths of a year, thousandths of a year, etc., in a reverse order at the left of years, extending the terms of the decimal years, when interminate, one place farther to the left than the terms of the nunber expressing the interest for one year. If the number of entire years exceeds* 9, *write the number of entire years and the decimal part as separate multipliers.*

3. *Regard the interest for one year divided by* 10, 100, 1000, *etc., which will give the interest for one-tenth of a year, one-hundredth of a year, one-thousandth of a year, etc.; multiply these interests respectively by the*

number of entire years, tenths of a year, hundredths of a year, thousandths of a year, etc., increasing each product by as many units as would have been carried to it from the product of the rejected terms, and one more when the second figure towards the right in the product of the rejected terms is 5 or more than 5; and take the sum of these products for the required interest.

NOTE 1.—In reducing days to decimal years, when solving problems, place the number of days at the right of years, with the divisor, 365, at the right of days. Determine whether the first quotient figure is tenths of a year or hundredths of a year by observing whether one or two ciphers must be annexed to the number of days in order to be divisible by 365, If more ciphers are required they need not necessarily be annexed to the number of days, as the work may be made more concise by annexing them to the remainders only. The operation may be still further abbreviated by not writing the divisor 365, nor the products of 365 by the quotient figures, since the work can be carried on mentally as in short division.

NOTE 2.—Common interest may be calculated by the same process as exact interest; but in reducing days to decimal years, divide by 360 instead of 365. In this reduction the decimal, when interminate, results in a circulate whose repetend, consisting of but one figure, is readily found by observing when a quotient figure will constantly repeat.

NOTE 3.—The following variation of the general rule will frequently be found more convenient: *Multiply the principal by the rate, and this product by the exact number of days, and divide the result by* 360 *or* 365, *accordingly as common or exact interest is required.*

ILLUSTRATIVE EXAMPLES.

1\. Required the interest of \$225, for 2 years and 40 days, at 8 per cent.

OPERATION.

\$225	
.08	
18.00	
5901.2	40.0(365
	365
36.00	
1.80	3500
.16	3285
1	
	2150
\$37.97 Ans.	

2\. Required the interest of \$256.75, for 93 days, at 5 per cent.

OPERATION.

\$256.75	
.05	
12.8375	
7452.0	93.0
	2000
2.57	1750
.64	2900
5	
1	
\$3.27 Ans.	

3\. Required the interest of \$400, for 10 years and 22 days, at 12 per cent.

OPERATION.

\$400	
.12	
48.00	
2060.0	22.00
10	1000
2.88	
1	
480.00	
\$482.89 Ans.	

4\. Required the interest of \$60.25, for 5 years and 73 days, at 7 per cent.

OPERATION.

\$60.25	
.07	
4.2175	
2.5	73.0
21.09	
.84	
\$21.93 Ans.	